Development of a Methanol Fuel Formulation for Use in Both Light- and Heavy-Duty Vehicles

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Objective

To identify and demonstrate a universal methanol fuel formulation(s) suitable for use in current and future light-duty vehicles and heavy-duty vehicles. If necessary, this strategy may include technically and economically feasible hardware modifications to light- or heavy-duty vehicles to enable satisfactory operation with the universal methanol fuel. If a universal methanol fuel formulation strategy proves to be impractical, the possibility of a simplified methanol fuel infrastructure will be researched.

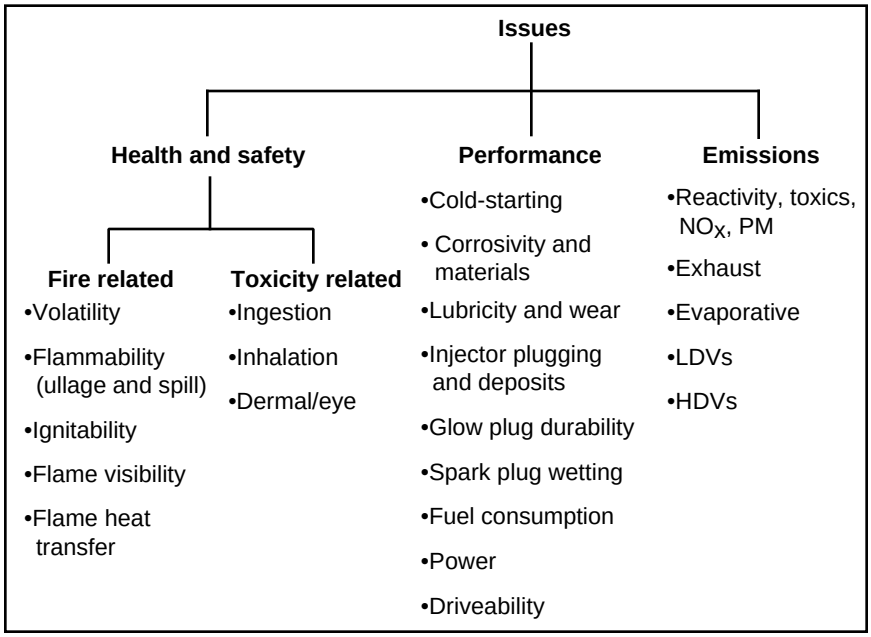

Figure 1: Technical issues affecting methanol fuel formulations for light- and heavy-duty vehicles

Approach

The project is to be accomplished in two phases. The first phase is comprised of a comprehensive engineering analysis and risk assessment of methanol fuel formulations and hardware solutions. The engineering analysis and risk assessment analyzes candidate methanol fuel formulations and hardware modifications. This assessment is based upon the physical properties of the fuels and a consideration of health and safety hazards, performance issues and emissions characteristics as shown in Figure 1. From these assessments, a small set of candidate methanol fuel formulations will be chosen that provide acceptable results for both light- and heavy-duty vehicles. The second project phase will encompass engine and vehicle testing of the chosen fuel formulations to validate the results of the engineering assessment and risk rating, and to narrow the candidate fuel formulations down to a single universal methanol fuel formulation. If hardware or infrastructure modifications are indicated, tests in the second phase will validate the feasibility of these modifications.

Accomplishments

The project has completed the risk and engineering assessments for five initial fuels, namely M85, M92, M100, gasoline and diesel. The first portion of the work involved generating a comprehensive database of relevant literature. The next step was to develop and perform a health and safety risk assessment which encompassed a set of 28 scenarios detailing various risks that included: fuel tank ullage flammability/explosion; fuel burning characteristics such as flammability, ignitability, flame visibility and radiation heat transfer; and fuel toxicity due to ingestion, inhalation and skin or eye contact. The assessment considered the likelihood of the scenario, the probability of a fuel-related accident, and the probable consequences. The results from this assessment, shown in Figure 2, indicate that the overall health and safety risks of M85, M92 and M100 are approximately the same, and that the risk of using a methanol blend (or neat methanol) is somewhere between that of using gasoline and diesel.

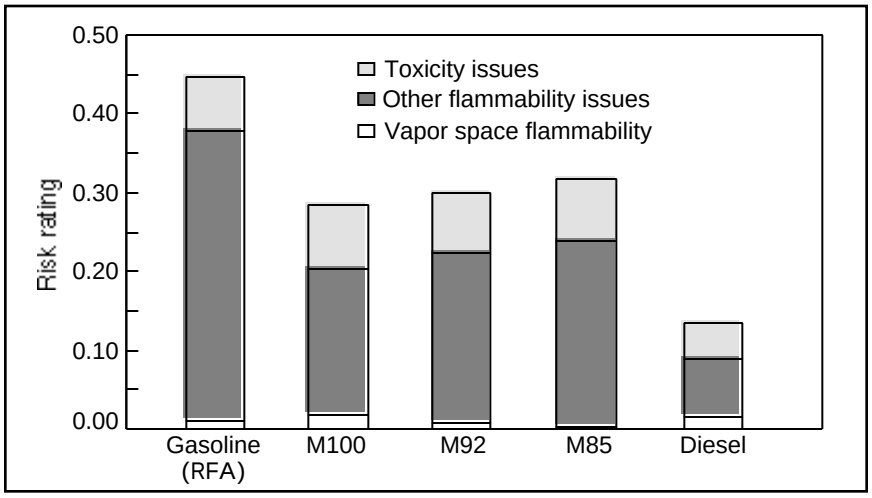

Figure 2: Health and safety risk assessment results for the five initial fuels

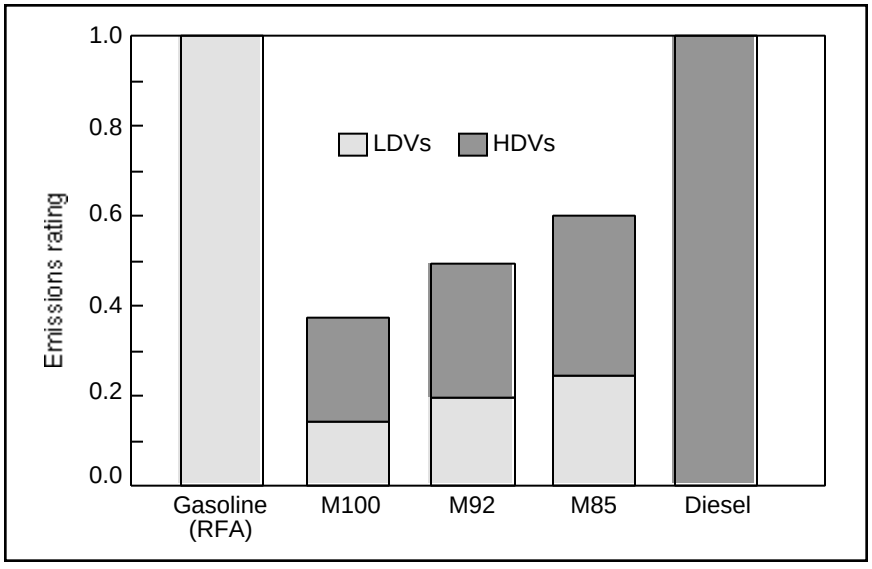

Figure 3: Emissions rating results for the five initial fuels

The next analysis concerned the emissions behavior of the various candidate fuels. Emissions behavior of various fuels in both light- and heavy-duty vehicles were examined. Careful effort was placed on designing the emissions rating assessment model to isolate the fuel effects from the vehicle effects. As shown in Figure 3, M100 has the best emissions rating (lowest) with emissions performance decreasing (higher value) as gasoline is added to the methanol.

The final analysis concerns the performance behavior of the fuel. While still in progress, the issues of cold starting in light- duty vehicles and injector plugging in heavy-duty vehicles play an important role in the fuel's performance rating.

Future Direction

Once the three assessments are completed for the five initial fuels, several other fuel blend/hardware modification combinations will be analyzed. Possible fuel/hardware combinations might include M100 with a cold-start device for light-duty vehicles, the optimum methanol/gasoline blend from the initial survey, methanol with a primer other than gasoline, and the current situation of M85 for light-duty vehi cles and M100 for heavy-duty vehicles. The fuel/hardware combinations with the lowest risk rating from the three analyses will be selected as the set of methanol fuel formulations to be tested in Phase II of the project. It is expected that Phase I of the project will be completed in September 1996.

Publications

"Working Toward a Universal Methanol Fuel Formulation," L.H. Browning, C.A. Powars and B.K. Bailey, presented at the XI International Symposium on Alcohol Fuels, Sun City, South Africa, April 1996.